

Claims

1. 1. An analysis-chip, which comprises one or more reactors with minimal height, wherein said reactor comprises at least:

1). one or more striped-capillary reaction-chambers, wherein said reaction-chamber comprises:

- i). top plane and bottom plane with a width more than 600 μ m;
- ii). probe-ligand and substrate probe-region in which said probe-ligand is immobilized;
- iii). closed partition-structure with a height of 1-1000 μ m, optimally 1-500 μ m;
- and iv). inlet and outlet,

2). reactor structure with minimal-height; which comprises at least open partition-structure comprising:

- i). substrate blank region with a width of 0.5-10mm; or/and
- ii). one or more following convexes with a height less than 1000 μ m, optimally less than 500 μ m: hydrophobic convex, highly-hydrophobic convex, and water-absorbing convex;
- and optionally, iii). convex flow-path comprising high-hydrophilic convex with a width of 5-4000 μ m, and a height of 0.05-1000 μ m, optimally 0.05-500 μ m relative to said substrate probe region;
- and optionally, reactor-protecting structure comprising protective unit with a distance less than 1000 μ m, optimally less than 500 μ m from said substrate probe-region;

and optionally, 3). marking-system convex, a marker-containing convex that does not cover said probe-ligand,

wherein:

- (1). said top plane and bottom plane are parts of top unit and bottom unit of said striped-capillary reaction-chamber, respectively;
- (2). said substrate probe-region is on said top plane or/and bottom plane;
- (3). said closed partition-structure is placed between said top plane and bottom plane;
- (4). material and dimension of said planes, and distance between said top plane and bottom plane are such that the capillary phenomenon of analysis media can take place in said striped-capillary reaction-chamber;
- (5). said substrate blank region and substrate probe region are on the same plane of a same substrate, which presents a water-absorptivity less than 0.1g/g and a contact angle of the surface static water as 40-80°;
- (6). said highly-hydrophobic convex contains, at least in its partial surface,

highly-hydrophobic material, wherein said highly-hydrophobic material presents a water contact angle of 40° bigger than that of said substrate probe region;

(7). said hydrophobic convex contains, at least in its partial surface, hydrophobic material, wherein said hydrophobic material presents a water contact angle as $55-80^\circ$;

(8). said water-absorbing convex contains, at least in its partial surface, water-absorbing material, wherein said water-absorbing material presents a water-absorptivity more than 0.1g/g ;

(9). said highly-hydrophilic convex contains, at least in its partial surface, highly-hydrophilic material, wherein said highly-hydrophilic material presents a water contact angle less than 40° ;

and (10). said protective unit closes at least partially said reactor structure when no sample is subjected, and it is irreversibly removed completely or partially when sample is to be subjected.

2. The chip of Claim 1, wherein:

1). said closed partition-structure presents a height of $1-300\mu\text{m}$, optimally $30-100\mu\text{m}$;

2). said top plane presents a width of $1000-15000\mu\text{m}$ and a length more than $1000\mu\text{m}$; and

3). said bottom plane presents a width of $1000-15000\mu\text{m}$ and a length more than $1000\mu\text{m}$.

3. The chip of Claim 1 or Claim 2, wherein said top plane and bottom plane in said striped-capillary reaction-chamber presents a width of $1500-15000\mu\text{m}$, optimally $2500-15000\mu\text{m}$.

4. The chip of anyone of Claims 1 to 3, wherein said closed partition structure includes one or more of the following reversible or irreversible enclosing structures:

1). thermal enclosing structure;

2). chemical enclosing structure;

3). reversible or irreversible adhesive layer;

4). highly-hydrophobic layer;

and 5). mechanic enclosing unit including coating, plate or tape of elastic polymer.

5. The chip of anyone from Claims 1 to Claim 4, wherein said top unit or/and bottom unit of said reaction-chamber present a thickness less than 1mm , optimally less than 0.2mm , and a detecting-light transparency rate more than 90% .

6. The chip of anyone from Claim 1 to Claim 5, wherein said probe-ligand is immobilized on either said top plane or said bottom plane, wherein said plane with said immobilized probe-ligand presents hydrophilic property whereas said plane without said immobilized probe-ligand presents hydrophobic property.

7. The chip of anyone from Claim 1 to Claim 6, wherein said top plane is made of glass material whereas said bottom plane is made of hydrophilic or hydrophobic plastic.
8. The chip of anyone from Claim 1 to Claim 7, wherein one or more said probe-ligands are immobilized in one area whereas one or more ligands of said ligands are immobilized in one other area in said probe region.
9. The chip of Claim 8, wherein said ligand and ligate include antigen and antibody.
10. The chip of anyone from Claim 1 to Claim 9, wherein said convex flow-path refers to a coating with said highly-hydrophilic material.
11. The chip of anyone from Claim 1 to Claim 9, wherein said convex flow-path comprises hydrophobic convex or/and highly-hydrophobic convex as its partition structure, wherein said convex presents a height less than 1000um, optimally less than 500um.
12. The chip of anyone from Claim 1 to Claim 11, wherein said convex flow-path comprises immobilized separating-media
13. The chip of Claim 12, wherein said separation media include electrophoresis media or chromatography media.
14. The chip of anyone from Claim 1 to Claim 11, wherein:
said highly-hydrophobic convex, hydrophobic convex, highly-hydrophilic convex, water-absorbing convex are formed respectively by solidifying liquid substance or/and immobilizing solid substance onto the surface of the chip;
said liquid substances include solution, paint, gel, emulsion containing the highly-hydrophobic material, hydrophobic material, highly- hydrophilic material, and water-absorbing material respectively; and
said solid substances include plate, film, board, strip, powder containing said highly-hydrophobic material, hydrophobic material, highly-hydrophilic material, and water-absorbing material respectively.
15. The chip of anyone from Claim 1 to Claim 14, wherein said highly-hydrophobic convex presents a height of 0.1-100μm.
16. The chip of anyone from Claim 1 to Claim 15, wherein said highly-hydrophobic material presents a water contact angle that is over 70° bigger than that of said substrate probe region.
17. The chip of anyone from Claim 1 to Claim 15, wherein said highly-hydrophobic material presents a water contact angle that is over 90° bigger than that of said substrate probe region.
18. The chip of anyone from Claim 1 to Claim 15, wherein said highly-hydrophobic

material presents a water contact angle that is over 110° bigger than that of said substrate probe region.

19. The chip of anyone from Claim 1 to Claim 18, wherein said highly-hydrophobic material includes highly-hydrophobic organic material or/and highly-hydrophobic nano-material.

20. The chip of Claim 19, wherein said highly-hydrophobic material includes one or more of the following materials:

- 1). highly-hydrophobic organosilicon and its derivatives;
- 2). highly-hydrophobic fluororesin and its derivatives;
- 3). highly-hydrophobic polymer; and
- 4). paint or/and solid substance containing highly-hydrophobic nano-particle.

21. The chip of anyone from Claim 1 to Claim 20, wherein said hydrophobic convex includes hydrophobic coating.

22. The chip of Claim 21, wherein said hydrophobic coating includes colored hydrophobic line, or/and colored hydrophobic strip.

23. The chip of anyone from Claim 1 to Claim 22, wherein said highly-hydrophobic material presents a surface static water contact angle of less than 30°.

24. The chip of Claim 23, wherein said highly-hydrophilic materials include highly-hydrophilic nano-material and nano-polymer material.

25. The chip of anyone from Claim 1 to Claim 24, wherein said water-absorbing material includes one or more of the following:

- 1). natural water-absorbing material;
- 2). solid porous material of hydrophilic inorganic compound; and
- 3). water-absorbing material of synthetic polymer.

26. The chip of Claim 25, wherein said water-absorbing material includes one or more of the following: a). capillary-structure-containing paper product, cotton product, or/and sponge as well as their modified materials, b). calcium salt; c). water-absorbing materials based on cellulose or its derivative, d). water-absorbing materials based on starch or its derivative, e). water-absorbing materials based on synthetic resin as well as compound generated by grafting, blocking and copolymerizing, paper product, cotton product, sponge and its modifier, calcium salt, water-absorbing cellulose material, water-absorbing starch material, and water-absorbing synthetic resin produced by grafting, blocking and copolymerizing.

27. The chip of anyone from Claim 1 to Claim 26, wherein said marking-system convex

refers to convex of controlled marker-releasing system,

wherein said controlled marker-releasing system comprises marker and presents a half-releasing-period of said marker of more than 10 seconds, optimally more than 30 seconds,

wherein said marker comprises labeling reagent and marking-ligand,

wherein:

1). said labeling reagent includes one or more of the following reagents: enzyme, fluorescent dyestuff, chemiluminescent catalyst, nonferrous metal or nonferrous metallic salt, dyestuff and paint;

and 2). said ligand includes one or more of the following substances: antigen, antibody, biotin, drug ligand polypeptides, DNA, RNA and the fragments thereof.

28. The chip of Claim 27, wherein said controlled marker-releasing system comprises said marker and controlled-releasing agent.

29. The chip of Claim 28, wherein said marking convex presents a height less than 1000 μ m, and is fixed around the array of said probe-ligand in said reactor or inside the array of said probe-ligand to form an array of probe-ligand and marking system.

30. The chip of anyone from Claim 27 to Claim 29, wherein said convex of controlled marker-releasing system includes mono-sandwiched or multi-sandwiched structure made up of said marker and controlled-releasing agent,

wherein said sandwiched structure refers to structure where the concentration of said marker is higher inside than outside.

31. The chip of anyone from Claim 28 to Claim 30, wherein said controlled-releasing agent includes water-soluble organic compound or organic compound that will disintegrate in water solution.

32. The chip of Claim 31, wherein said organic compound includes one or more of the following materials: carbohydrate and its derivatives thereof, plant starch and modified starch, plant glue, animal glue, modified cellulose, polymer and condensate.

33. The chip of anyone from Claim 1 to Claim 32, wherein said protecting unit includes one or more of the followings: organic film or/and plate, film or/and plate of metal-organic complex, and slide.

34. The chip of Claim 33, wherein said protecting unit is connected with the reactor through one or more of the following reversible/ irreversible enclosing structures: thermal enclosing structure, chemical enclosing structure and reversible or irreversible adhesive layer.

35. The chip of Claim 33 or Claim 34, wherein said protecting unit is precut for the

convenience of possible removal.

36. An analysis-chip, which comprises one or more reactors with minimal-height, wherein said reactor comprises probe-ligand, substrate probe region, open partition-structure with minimal height, and optionally, reactor-protecting structure, wherein said open partition-structure comprises:

1). substrate blank region with a width of 0.5-10mm;
2). highly-hydrophobic convex or/and water-absorbing convex, all of which presents a height less than 1000 μ m, optimally less than 500 μ m relative to said substrate probe region, wherein:

(1). said substrate blank region and substrate probe region are on the same plane of a same substrate, which present a water contact angle as 40-80°;

(2). said highly-hydrophobic convex contains, at least in its partial surface, highly-hydrophobic material, wherein said highly-hydrophobic material presents a water contact angle of 40° bigger than that of said substrate probe region;

and (3). said water-absorbing convex contains, at least in its partial surface, water-absorbing material, wherein said water-absorbing material presents a water-absorptivity more than 0.1g/g.

37. The chip of Claim 36, wherein said reactor is open reactor.

38. The chip of Claim 36 or Claim 37, wherein:

said highly-hydrophobic convex comprised in said open partition structure is said highly-hydrophobic convex of anyone from Claim 15 to Claim 25; and/or

said water-absorbing convex is said water-absorbing convex of Claim 15 or Claim 24 or Claim 25; and/or

said protection structures include said protection structures of Claim 1 or anyone from Claim 33 to Claim 35.

39. An analysis-chip, which comprises one or more open non-flow reactors with minimal-height,

wherein said reactor comprises at least probe-ligand, substrate probe region, open partition-structure with minimal height, and optionally, reactor-protecting structure,

wherein said open partition-structure comprises:

1). substrate blank region with a width of 0.5-10mm;

and optionally, 2).hydrophobic convex with a height less than 1000 μ m, optimally less than 500 μ m relative to said substrate probe region,

wherein:

(1). said substrate blank region and substrate probe region are on the same plane of a same substrate, which presents a water-absorptivity less than 0.1g/g and a water contact angle as 40-80°;

and (2). said hydrophobic convex contains, at least on its partial surface, hydrophobic material, wherein said hydrophobic material presents a water contact angle of 55-80°.

40. The chip of Claim 39, wherein:

said hydrophobic convex comprised in said open partition structure is the hydrophobic convex of Claim 21 or Claim 22; and/or

said protection structure includes the protection structure of Claim 1 or anyone from Claim 33 to Claim 35.

41. An analysis-chip, which comprises one or more flow or non-flow reactors with minimal-height,

wherein said reactor comprises at least one or more striped-capillary reaction-chambers with a height of less than 1000µm, optimally 500µm, and optionally, reactor-protecting structure,

wherein said reaction-chamber comprises:

- 1). top plane and bottom plane with a width more than 600µm;
- 2). probe-ligand and substrate probe-region in which said probe-ligand is immobilized;
- 3). closed partition-structure with a height of 1-1000µm, optimally 1-500µm; and
- 4). inlet and outlet,

wherin:

(1).said top plane and bottom plane are parts of top unit and bottom unit of said striped-capillary reaction-chamber, respectively;

(2). said substrate probe-region is on said top plane or/and bottom plane;

(3).said closed partition-structure is placed between said top plane and bottom plane;

(4). material and dimension of said planes, and distance between said top plane and bottom plane are such that the capillary phenomenon of analysis media can take place in said striped-capillary reaction-chamber;

and (5). said substrate probe-region presents a water-absorptivity less than 0.1g/g and a water contact angle as 40-80°.

42. The chip of Claim 41, wherein:

said striped-capillary reaction-chamber is that of anyone from Claim 2 to Claim 9; and/or

said protection structure includes the protection structure of Claim 1 or anyone from Claim 33 to Claim 35.

43. An analysis-chip, which comprises one or more flow reactors with minimal-height, wherein said reactor comprises at least:

- 1). probe-ligand,
 - 2). substrate probe region with a water-absorptivity less than 0.1g/g and a water contact angle as 40-80°;
 - 3). convex flow-path comprising high-hydrophilic convex with a width of 5-4000µm and a height of 0.05-1000µm, optimally 0.05-500µm relative to said substrate probe region;
- and optionally, 4). reactor-protecting structure,

wherein said high-hydrophilic convex contains, at least in its partial surface, highly-hydrophilic material, wherein said highly-hydrophilic material presents a water contact angle less than 40°.

44. The chip of Claim 43, wherein:

said convex flow path is that of anyone from Claim 10 to Claim 25; and/or

said protection structure includes the protection structure of Claim 1 or anyone from Claim 33 to Claim 35.

45. The chip of Claim 43 or Claim 45, wherein said reactor is open reactor.

46. The chip of anyone from Claims 43 to Claim 45, wherein said reactor comprises the open partition structure of Claim 1 or anyone from Claim 14 to Claim 26.

47. An analysis-chip, which comprises one or more reactors with minimal-height, wherein said reactor comprises at least probe-ligand, substrate probe region, marking-system convex, and optionally, reactor-protecting structure, wherein said marking-system convex refers to marker-containing convex that does not cover said probe-ligand.

48. The chip of Claim 47, wherein said reactor is open reactor.

49. The chip of Claim 47 or Claim 48, wherein:

said marking system convex includes marking system convex according to anyone of Claim 26 to 30; and/or

said protection structure includes the protection structure according to Claim 1 or anyone of Claim 33 to 35.

50. An analysis-chip, which comprises one or more reactors with minimal height, wherein said reactor comprises:

- 1). easily-detachable substrate easily dismantled if needed, or/and
- 2). reactor-protecting structure with minimal-height, comprising protective unit, wherein:
 - i). Said height, a distance from substrate probe-region to bottom plane of said

protective unit is less than 1000 μm , optimally less than 500 μm ;

and ii). said protective unit closes at least partially said reactor structure when no sample is subjected, and it is irreversibly removed completely or partially when sample is to be subjected.

51. The chip of Claim 50, wherein said protection structure includes the reactor-protecting structure of Claim 1 or anyone from Claim 33 to Claim 35.

52. An analysis-chip with a high density of reactors, wherein:

- 1). said density of reactors is more than 2 reactors/ cm^2 , optimally more than 3 reactors/ cm^2 on at least one plane of a substrate; and
- 2). said reactor comprises partition structure with a height less than 1000 μm , optimally less than 500 μm .

53. The chip of Claim 52, wherein said reactor density is more than 5 reactors/ cm^2 .

54. The chip of Claim 52 or Claim 53, wherein said reactor refers to the reactor with a minimal height of partition structure of Claim 1 to Claim 51.

55. A top unit or a bottom unit used in said analysis-chip of anyone from Claim 1 to Claim 34, said top unit or bottom unit comprising the probe region on substrate and the probes immobilized therein.

56. A base-plate, comprising:

- 1). more than one of substrate probe regions; and
- 2). one or more of the following reactor structures:

the convex flow path of Claim 1 or anyone from Claim 9 to Claim 13; or

the open partition structure of Claim 1 or anyone from Claim 14 to Claim 24.

57. A qualitative or/and quantitative analysis method, comprising:

(b) subjecting the sample into the open reactor in an analysis-chip and making the reaction therein; and

(b) after the reaction is completed, the residual sample needn't cleaned out from the reactor and the followed procedures are carried on directly, said followed procedures include washing or labeling.

58. The method of Claim 57, wherein said analysis-chip with said open reactor is the analysis-chip with more than one of open reactors of anyone from Claim 36 to Claim 39.

59. A qualitative or/and quantitative analysis method, including:

- (b) subjecting the sample into the reactor of analysis-chip and taking probe-selective reaction and labeling reaction therein at the same time;
- (b) washing the reactor and analyzing the result of the reaction.

60. A method of Claim 59, wherein said analysis-chip is that of anyone from Claim 1 to Claim 54.

61. A device for detection, said device comprising the pieces for cleaning up the residual in the reactor after the reaction is finished, said pieces performing said cleaning through absorption with water-absorbing material, or/and through washing directly on the chip with an included angle with horizontal plane, said water-absorbing material presents a water-absorptivity larger than 0.5g/g; said included angle is bigger than 5°.